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NAVWEPS OP 2626

**5.0-INCH HIGH-PERFORMANCE FOLDING-FIN
AIRCRAFT ROCKET
ZUNI**

DESCRIPTION, OPERATION, AND MAINTENANCE (U)

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SAFETY SUMMARY

The "Warnings" contained in this publication and the pages on which the "WARNINGS" appear are listed in the following paragraphs. All personnel involved in the operation and maintenance of the ZUNI must fully understand the "WARNINGS" and the procedures by which the hazard is to be reduced or eliminated.

All SAFETY PRECAUTIONS, specific and general, are summarized in chapter 5. Personnel should become thoroughly familiar with all aspects of safety of personnel and equipment prior to the operation and maintenance of ZUNI.

WARNING

The LAU-10/A launcher shall not be attached to a bomb rack that does not have separate ignition and jettisoning circuits. Page 19

WARNING

The launcher has two shorting devices. Make sure the shorting device being used is in the SAFE position until aircraft is ready for takeoff. Page 19

WARNING

To prevent accidental ignition by electromagnetic or electrostatic energy, the shielding band must be left in place until just before the contact band enters the launcher. Page 23

WARNING

Firing-circuit continuity check with rocket motors installed in the launcher should be made only by a Naval Ammunition Depot and should be made in strict conformance with the specified procedures, using equipment designed for that purpose. Page 24

WARNING

During loading or unloading operations do not touch the rocket motor contact band. Page 24

WARNING

If the motor is dropped and any portion impacts after falling 18 inches or more, do not use. If convenient, return motor to the issuing agency with a tag showing pertinent information.

Page 25

WARNING

The lower storage limit for the ZUNI rocket motor is -30 degrees Fahrenheit. Should any motors be exposed to a colder temperature they shall be conditioned at a temperature above -30 degrees Fahrenheit for six hours before being used to arm aircraft.

Page 25

WARNING

Test of the intervalometer shall never be made except on empty launchers.

Page 27

WARNING

Before reloading a used launcher, the intervalometer shall always be operated as indicated in Chapter 4 and left in the home or original ZERO position.

Page 27

WARNING

For Mk 24 Mod 0 head only.

a. No attempt should be made to remove the base fuze except by qualified bomb-disposal personnel.

Page 33

b. Leave heads in shipping container as long as possible when loading aboard or striking down.

c. When off-loading, provide shipping container Mk 34 box or Mk 11 pallet adapter. Secure to pallet to prevent rolling off.

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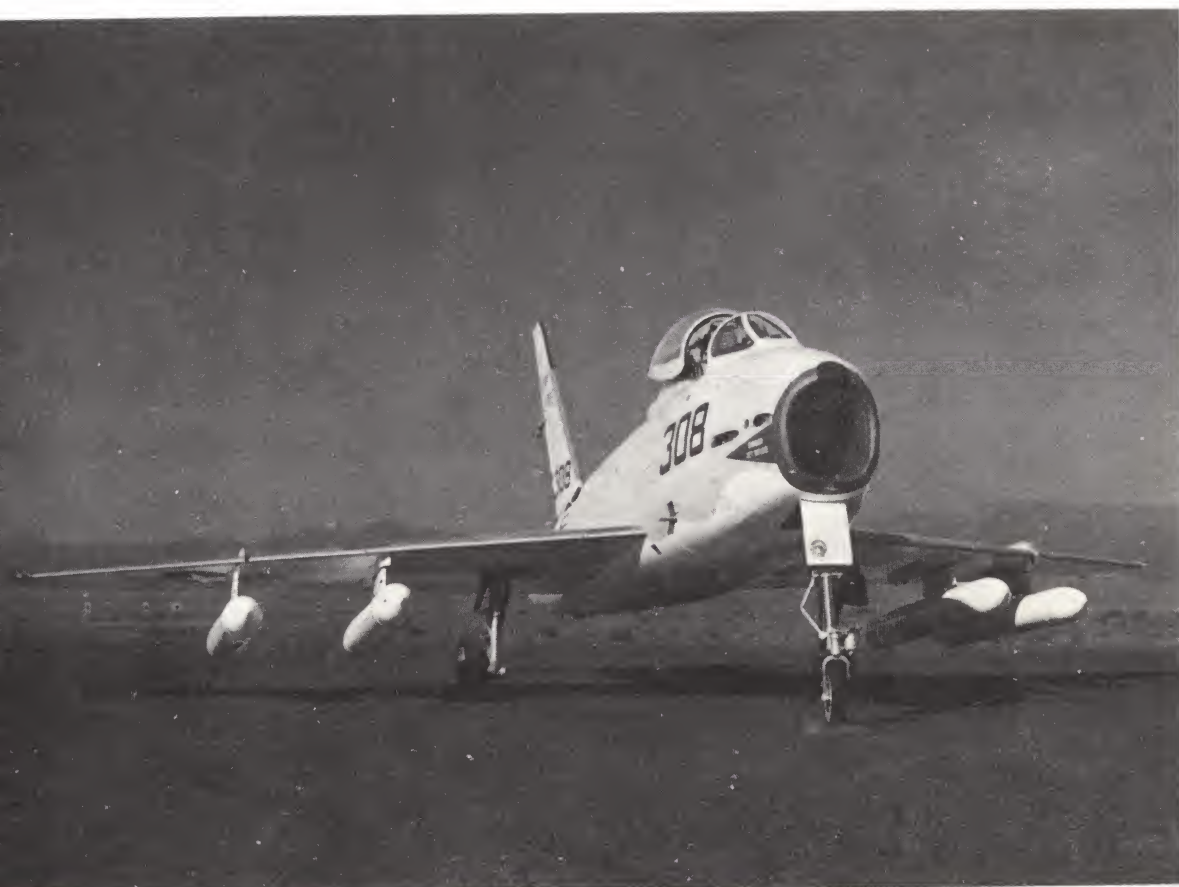
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SAFETY SUMMARY

d. When handling individual heads, use extra caution. Do Not Drop. Treat any head dropped more than 10 feet as armed.

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Frontispiece – ZUNI Loaded on Aircraft.

Chapter 1

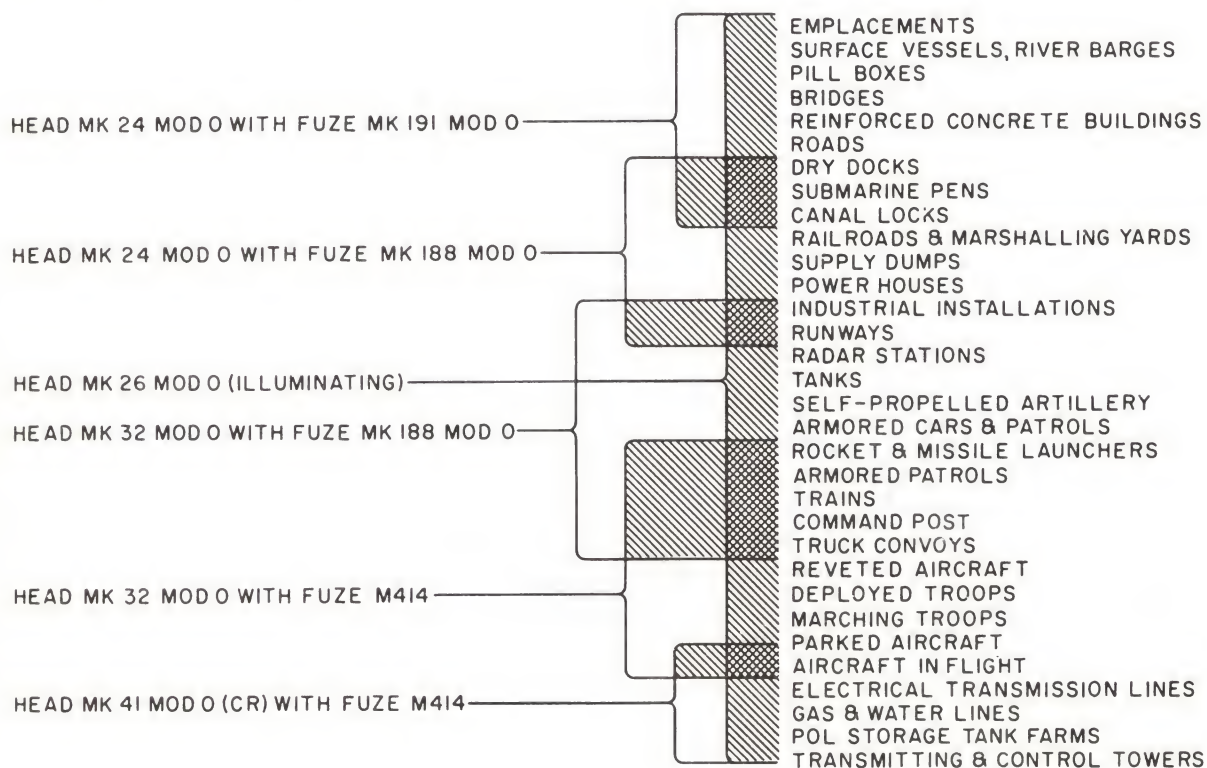
INTRODUCTION

The ZUNI weapon system, which consists of supersonic unguided 5.0-inch rockets in a four-round package launcher, is designed for use on jet fighter or propeller aircraft and replaces the 5.0-inch HVAR.

The ZUNI rocket is used for air-to-ground attack. A reliable high-performance motor with an internal-burning, solid-propellant grain gives ZUNI high velocity and short time-to-target. Blast-operated radially folding fins stabilize the rocket's flight for minimum dispersion. An array of interchangeable warheads

provides effectiveness in a wide variety of tactical situations. Matching the versatility in payload, ZUNI fuzing gives an option of influence, contact, or time-delay detonation. Effectiveness of the various ZUNI combinations against specific targets is listed in Table 1.

The ZUNI system consists of the 5.0-inch Rocket Motor Mk 16 Mod 1, three optional rocket heads, three fuzes, and the LLU-10/A launcher with frangible fairings, figure 1. Each head, properly fuzed, is suitable for a specific type of action. The warheads



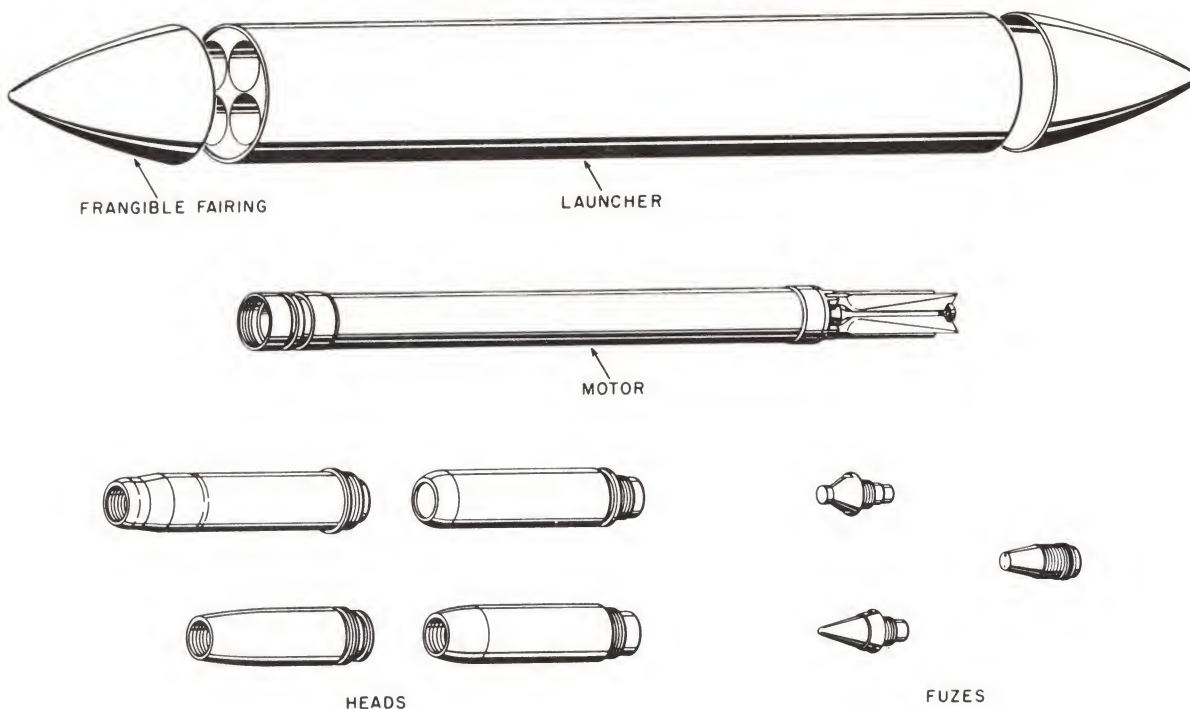


Figure 1 - ZUNI Weapon System.

designed for the ZUNI are: (1) shaped-charge with controlled fragmentation, (2) general purpose, (3) flare for night illumination. Since the trajectory of the 2"75 FFAR is similar to that of the ZUNI, the 2"75 Rocket will be used as the practice round for the larger, more expensive round.

The ZUNI rockets are launched from the LAU-10/A launcher. This launcher is a reusable package for shipping, without heads, stowing, and firing four 5.0-inch ZUNI rockets. When used as a launcher, frangible fairings are secured over the ends of the LAU-10/A launcher. The frangible fairings are made of a material that shatters readily on rocket movement and rocket blast without damage to the aircraft.

Major Components

The major components of the ZUNI weapon system are as follows:

- 5.0-inch Rocket Motor Mk 16 Mod 1
- 5.0-inch Rocket Head Mk 32 Mod 0 (ATAP)
- 5.0-inch Rocket Head Mk 24 Mod 0 (GP)
- 5.0-inch Rocket Head Mk 26 Mod 0 (Illuminating)
- Fuze 188 Mod 0 (PD)
- Fuze M 414 (Proximity)
- Fuze Mk 191 Mod 0 (BD)
- LAU-10/A Launcher
- Frangible Fairings

References

The following publication is referred to in this Ordnance Pamphlet:

OP 1239 (First Revision). 5"0 Rockets (5"0 Motor, Fin-Stabilized), Description and Instructions for Use, 25 March 1954. CONFIDENTIAL.

Applicable Publications

1. NOTS TP 2244 (Rev. 1). ZUNI--5.0-Inch High-Performance Folding-Fin Aircraft Rocket, A Handbook for the Ordnanceman (U). China Lake, Calif., NOTS, 29 September 1959.

2. NOTS 1478, Rev. 1. ZUNI, 5.0-Inch General Purpose Folding-Fin Aircraft Rocket, China Lake, Calif., NOTS, 1 October 1958. CONFIDENTIAL.

3. NAVORD REPORT 5901, NOTS 2054. An Evaluation of the Terminal Effectiveness of the 5.0-Inch Rocket With Various Warheads

as an Air-to-Air and Air-to-Ground Weapon (U), by E. A. Zeitlin. China Lake, Calif., NOTS, 24 July 1958. CONFIDENTIAL.

4. OP 2682. Firing Tables Air-to-Ground for 5.0-Inch Folding-Fin Aircraft Rockets Marks 40 and 41 and Mods (ZUNI) (U). 23 January 1959.

5. OPDEVFOR Final Report Project OP/V229/X23 Task One, Capability of the 5"0 Aircraft Rocket (ZUNI) as an Air-to-Ground Weapon. Operational Development Force, U. S. Fleet, 8 August 1957.

6. NAVORD INSTRUCTION 8042.17 dated 28 October 1954. Rocket Head Mk 24 Mod 0 With Base Fuze Mk 191 Mod 0 for ZUNI 5"0 Folding-Fin Aircraft Rocket; Safety Precautions for Handling and Use.

Chapter 2

PHYSICAL AND FUNCTIONAL DESCRIPTION

The ZUNI weapon system, consisting of three rockets with fuzeed heads, the launcher, and frangible fairings, is approximately 139 inches long, 14 inches maximum in diameter, and weighs approximately 533 pounds. A 5.0-inch ZUNI rocket with Mk 32 head and M 414 proximity fuze is shown in figure 2.

The motors are shipped completely assembled in the LAU-10/A launcher or in individual wooden shipping containers. The heads are shipped in individual wooden boxes--one or two to a box. The fuzes are shipped in separate containers--32 to a container; except the Mk 191 fuze, which is permanently installed in the Mk 24 head when assembled. Six frangible fairings, enough to equip three launchers, are contained in a separate carton. Another package, which is attached to the pallet load at the Naval Ammunition Depot, contains special launcher equipment--

the detent-lift tool, figure 3, and the ignition post, figure 4.



Figure 3 - Detent-Lift Tool.

5.0-Inch Rocket Motor Mk 16 Mod 1

The components of the motor, figure 5, are described in the following paragraphs:

MOTOR TUBE. The aluminum-alloy tube of the motor is 77 inches long maximum with a maximum outside diameter of 5 1/8 inches.

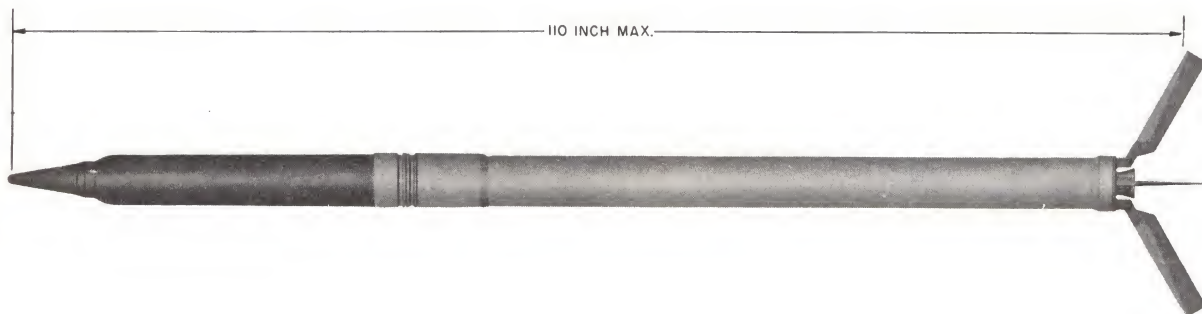


Figure 2 - ZUNI Rocket with Mk 32 Head and M 414 Proximity Fuze.



Figure 4 - Ignition Post.

ector is screwed into the head end of the motor. This thread protector should not be removed until just before the rocket head is attached.

An external contact band at the forward end of the motor tube permits the flow of electrical current to the squib.

SHIELDING BAND. A shielding band is attached to the motor tube over, but not in contact with, the contact band. The purpose of the shielding band is to serve as an electromagnetic shield and to prevent personnel from inadvertently touching the contact band.

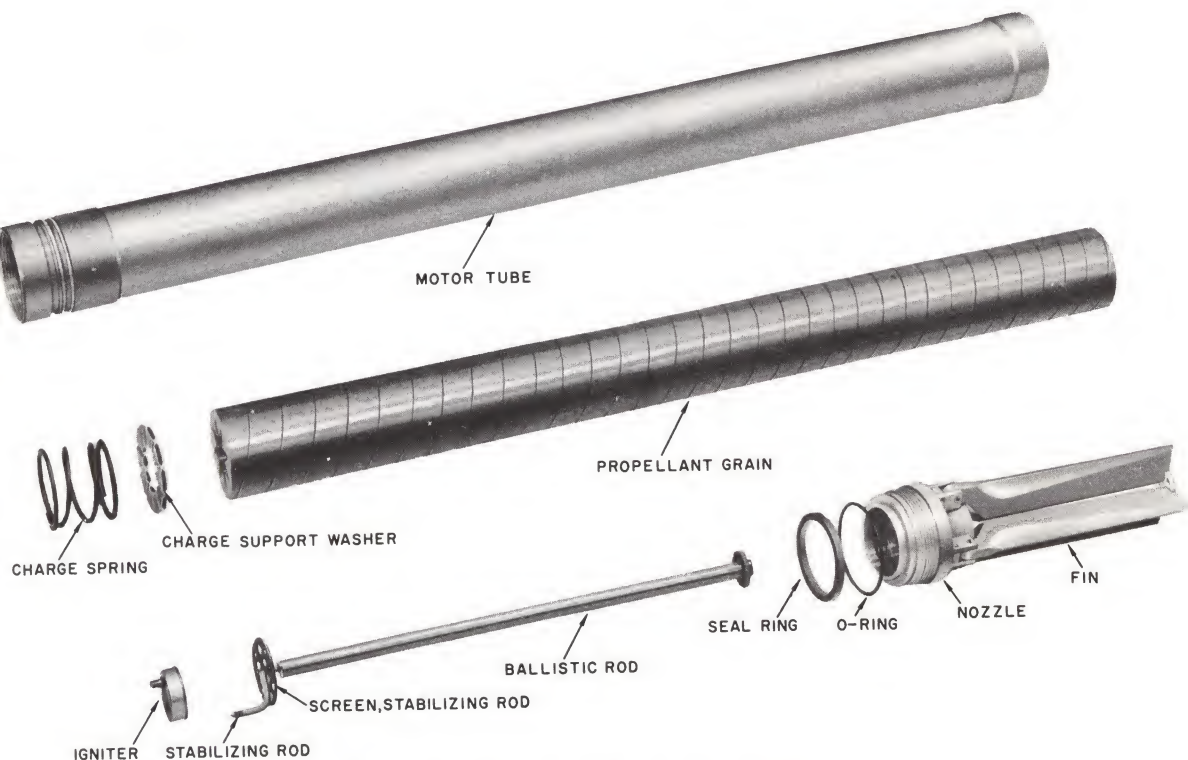


Figure 5 - Exploded View of the Motor.

Tapered Acme threads at the forward end are machined to accept the rocket head. When motors are shipped individually, a thread pro-

NOZZLE ASSEMBLY. The nozzle assembly consists of a steel nozzle, four aluminum-alloy fins, and steel fin-locking pawls. The fins are 13

inches long and 2.3 inches wide. They are uniformly tapered in thickness from the pivot to the tip. A light plastic retainer holds the fins folded within the 5 1/8-inch diameter of the round. On ignition, the fin retainer is blown off, and gas pressure on the heels of the fins pushes them open. The fins open to flight position in about 20 milliseconds, or about 4 feet of travel, after emerging from the launcher. The spring-loaded pawls then hold the fins in flight position against aerodynamic drag. The action of the nozzle is depicted in figure 6. A special treatment provides a heat-barrier coating over the entire fin surface to prevent erosion by hot exhaust gas. To protect the propellant charge from moisture,

the nozzle opening is closed by a thin metal seal, which is shattered by the blast upon ignition.

PROPELLANT GRAIN. The ZUNI uses an internal-burning, double-base, solid-propellant grain that weighs approximately 33.5 pounds. The nozzle end of the propellant grain seats against a rubber seal ring on the nozzle. A helical steel spring at the head end of the propellant grain pushes it back against the rubber seal ring, preventing the flow of hot gas through the space between the propellant grain and the motor tube. Space between the outside diameter of the grain and the inside diameter of the motor tube exists only at temperatures of approximately 100°F and below. At

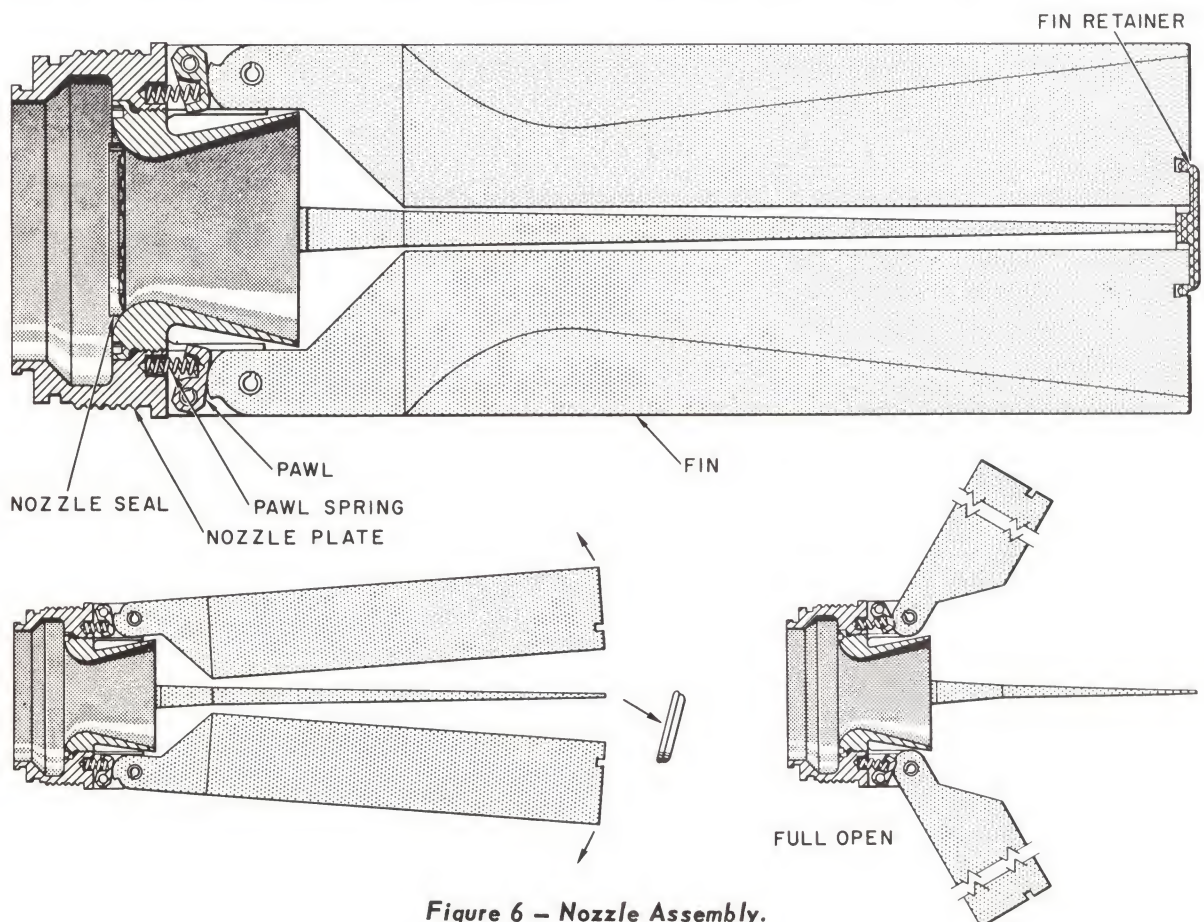


Figure 6 - Nozzle Assembly.

higher temperatures, the expanded grain is in contact with the motor tube.

This propellant grain has a thin-walled star-perforated configuration which is subject to embrittlement and possible cracking at extremely low temperatures. Such cracking could cause motor burn through or blowup which would endanger the firing aircraft. It is therefore necessary to restrict the minimum storage temperature of the round to -30 degrees Fahrenheit.

This storage temperature limitation does not impose a restriction on the tactical use of the ZUNI weapon since the round is carried in the LAU 10/A launcher which provides thermal protection. Calculations and thermocouple tests confirm that rounds taken aloft after soaking at -30 degrees F cannot reach a significantly lower temperature within the flight capability of the aircraft, in both time and altitude.

BALLISTIC ROD. A ballistic rod through the center of the star-shaped grain perforation in the forward section smooths the burning, prevents flameout, and suppresses flash. This ballistic rod, attached securely to the motor-tube bulkhead, is made of 3/16-inch diameter steel rod coated with a plasticized potassium-sulfate composition.

IGNITER. The igniter, located at the head end of the motor, is about 2.6 inches in diameter and 3/4-inch thick. It is charged with FFFG black powder and coated-magnesium powder. Two Mk 1 squibs connected in parallel initiate the igniter.

Heads

5.0-INCH ROCKET HEAD MK 32 MOD 0 (ATAP). The Mk 32 Mod 0 rocket head, anti-tank, anti-personnel (ATAP), similar to the HVAR Rocket Head Mk 25 Mod 0, is shown in figure 7. The head is 29 inches long, its steel shell is 1/8-inch thick, and its weight with fuze is 48 pounds, of which 15 pounds is high-explosive Composition B. Containing a plastic liner to control fragmentation, the head emits, upon detonation, more than 2000 high-speed, 1/4-inch-square fragments. Field tests of this head have shown capability sufficient to damage vehicles from a miss-distance as great as 70 feet from the target.

Used in ZUNI, the Mk 32 head with a point-detonating fuze (Mk 188 Mod 0) effects shaped-charge action, being capable of penetrating armor 7 inches thick at 65-degrees obliquity or 18 inches thick at zero-degree obliquity. Thus the Mk 32 head is highly effective against heavy targets, such as tanks or bunkers.

The Mk 32 head has a cavity liner to prevent exposing the explosive when fuzes are being changed.

For fragmentation action against aircraft or personnel, a proximity fuze, M 414, may be attached to the head and used with effectiveness.

5.0-INCH ROCKET HEAD MK 24 MOD 0 (GP). The Mk 24, general purpose (GP) head, shown in figure 8, with nose fuze installed, is 18 inches long, weighs 48 pounds, and carries 10 pounds of explosive. Upon detonation the head produces more than 500 fragments that penetrate 3/8-inch-thick mild-steel

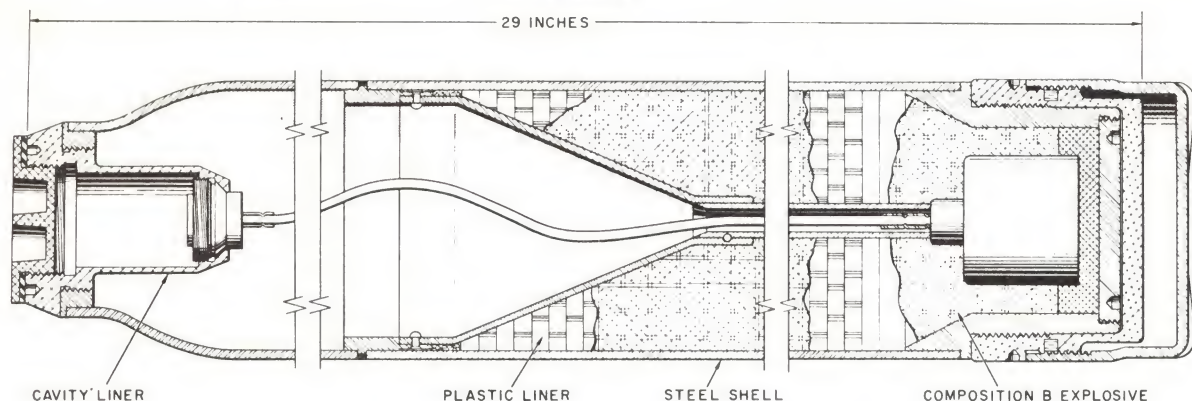


Figure 7 - 5.0-Inch Rocket Head Mk 32 Mod 0 (ATAP).

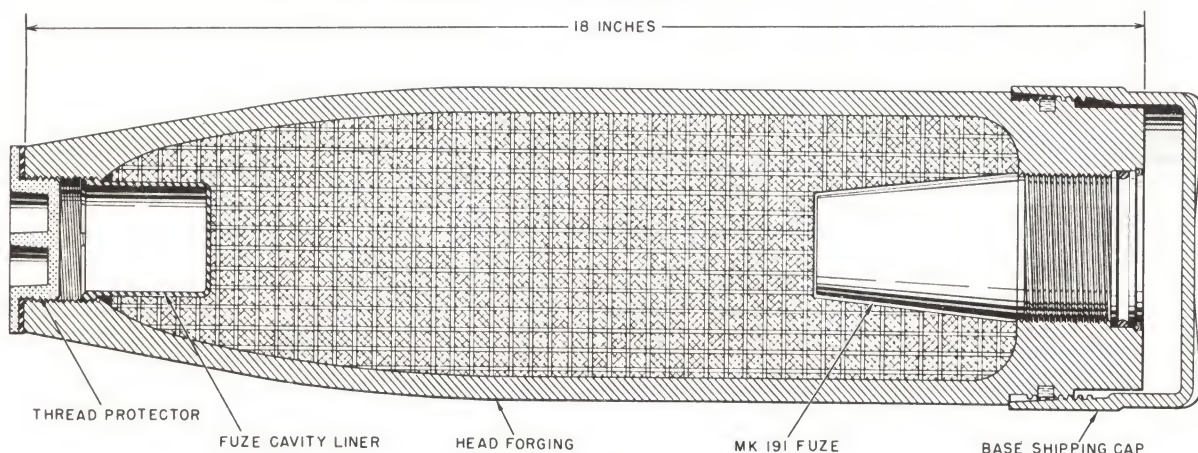


Figure 8 - 5.0-Inch Rocket Head Mk 24 Mod 0 (GP).

plate at 30 feet. This head may be fuzed for contact, influence, or delayed detonation. The Mk 24 head has a 5-millisecond-delay base fuze, Mk 191 Mod 0, permanently assembled into it, which when used with a steel nose ogive, BuOrd Dwg 458162, makes it a delayed-action warhead. (WARNING, Chapter 5).

The steel nose ogive enables the head to penetrate heavy targets such as concrete bunkers and ships, and to detonate inside the target.

In field tests, the Mk 24 head penetrated 2 inches of Class B armor, 3 feet of reinforced concrete, and up to 30 feet of soft earth.

The heavier fragments of the Mk 24 head are most effective against personnel, jet aircraft engines, light vehicles, and oil- or liquid-storage tanks.

The M 414 proximity and the Mk 188 point-detonating fuzes, listed on the 5.0-inch Rocket Head Mk 32 Mod 0, are just as effective when used on the Mk 24 head.

A metal fuze-cavity liner is used at the nose end of the head. It is screwed and cemented into the head so that it remains permanently in place. This liner prevents exposure of the high explosive when nose fuzes are being attached or detached.

5. 0-INCH ROCKET HEAD MK 33 MOD 0 (ILLUMINATING). The Mk 33 head, figure 9, is a 27-inch-long cylindrical case containing a fuze, a flare candle, a main suspension parachute and its pilot chute, a delay-action mechanism, and a drag parachute. A head base, threaded to fit the rocket motor, seals the case.

The mechanical time fuze, armed by acceleration forces of the rocket, has an escapement that provides energy to ignite a 13-gram black-powder charge in the fuze which, in turn, ignites the flare candle and ejects the outer case from the rest of the head.

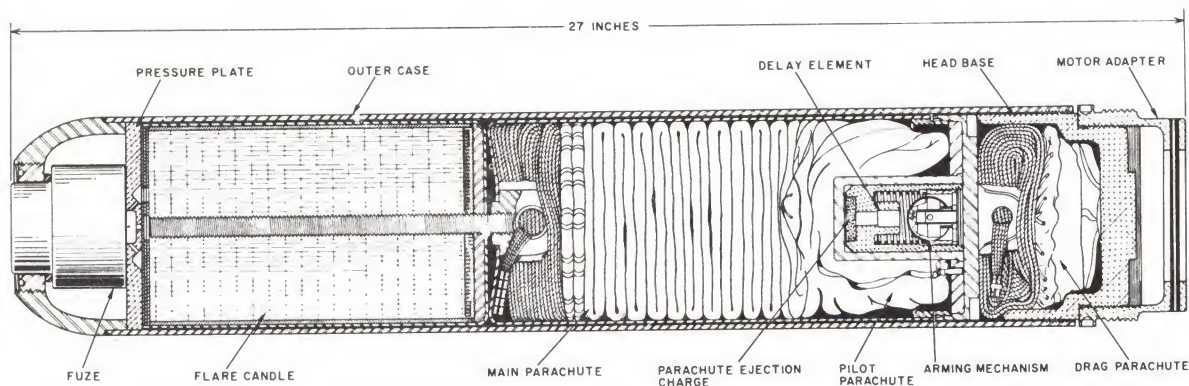


Figure 9 - 5.0-Inch Rocket Head Mk 33 Mod 0 (Illuminating).

The Mk 33 flare head is used to illuminate surface targets for night attack. The rocket motor propels the flare head approximately 6000 yards from the launching point. At this distance a mechanically timed 14-second delay fuze functions, separating the head from the motor and igniting the flare candle, which is suspended by a parachute. The flare candle descends approximately 1000 feet during the flare's 70 seconds of burning time. During descent, an illumination of 1,720,000 candle power is produced by the flare candle which, combined with the ability to place the rocket 6000 yards ahead, enables the pilot to illuminate his target and destroy it with explosive-loaded ZUNI rockets in a single pass, thus preserving an element of surprise.

When the rocket is launched, its acceleration starts the arming sequence of the fuze. Acceleration also turns a rotor that arms the parachute-ejection mechanism in 600 feet of travel; the firing pin on the rotor is aligned with the primer of the delay element. The fuze functions 14 seconds after the flare is launched.

The flare candle, located inside the case aft of the fuze, is a steel can with cardboard liner into which 7 pounds of pyrotechnic material is pressed. The can containing the pyrotechnic is attached to a similar can that contains the main and the pilot parachutes. The main parachute is 7 feet in diameter; it is made of nylon and has steel shroud lines.

As the flare load tumbles out, the drag parachute is withdrawn from the cavity in the head, and it opens. During the 4.5-second-delay action of the delay element, this parachute reduces the velocity of the flare load from about 1000 to 400 feet per second--the maximum velocity the main parachute will withstand. At that time, the main parachute can open without danger of damage to the canopy or shrouds.

Fuzes

Three types of fuzes are available for use with ZUNI. A fuze may be selected for point detonating (PD), base detonating (BD), or proximity detonating (VT).

FUZE MK 188 MOD 0 (PD). The Mk 188 Mod 0 PD fuze may be attached to the nose of the 5.0-inch Rocket Heads Mk 32 Mod 0 and Mk 24 Mod 0. The fuze, unarmed and armed, is shown in figure 10. With ZUNI launched at 550 knots, the fuze will arm on acceleration or a combination of acceleration and deceleration at distances of 1000 to 2000 feet. It functions on a minimum of target thickness of 0.016-inch-thick 24ST aluminum. If a rocket is accidentally fired on the deck of an aircraft carrier, the fuze will not arm within the length of the carrier; therefore, the fuze is carrier-safe.

The Mk 188 fuze is equipped with a striker arm attached to a striker plate in the nose section of the fuze

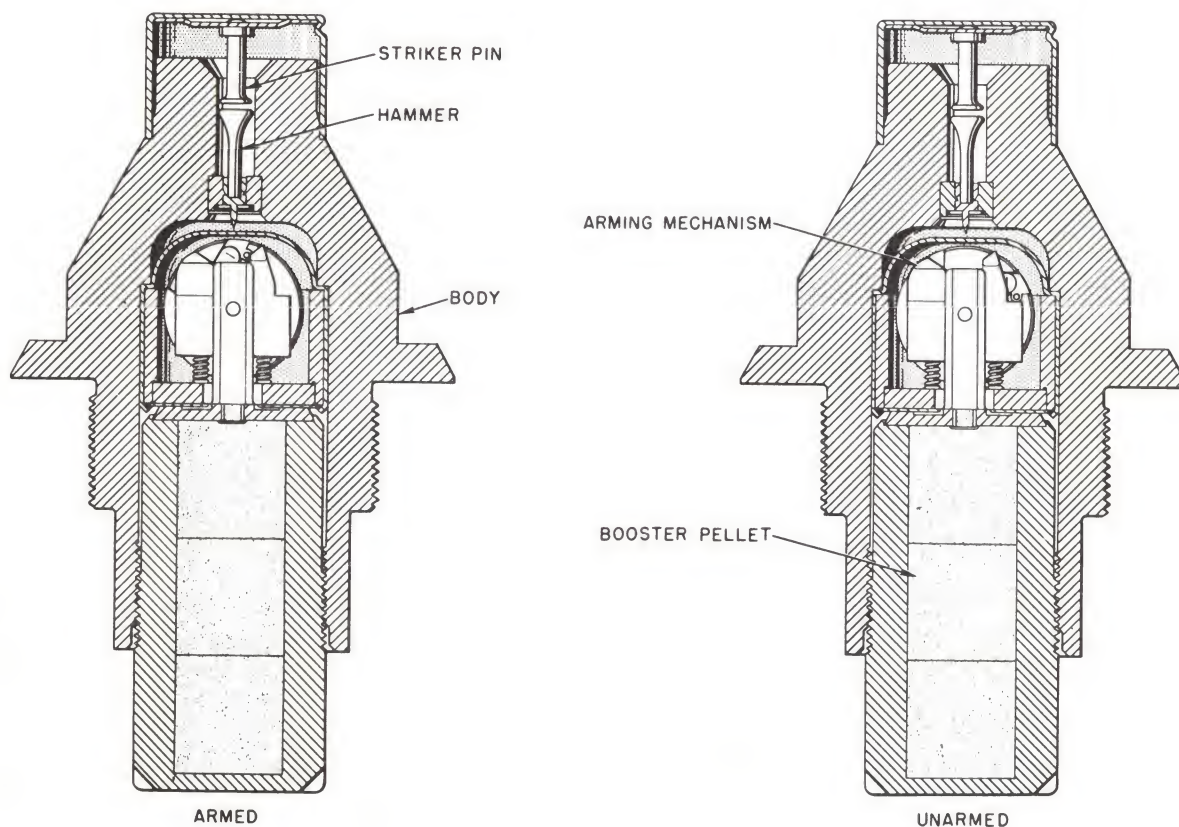


Figure 10 - Fuze Mk 188 Mod 0 (PD), Unarmed and Armed.

body. A plastic hammer and a stab-action firing pin are supported by an anti-setback washer. The explosive train is contained in an unbalanced rotor and consists of a sensitive primer and a detonator. The rotor is held in its unarmed position by an acceleration-operated, spring-controlled setback weight. An acceleration of 13 to 15 g moves the setback weight aft, causing the unbalanced rotor to start turning toward the armed position, figure 10. If the force is a transient one, such as occurs during jolt testing, dropping, or transporting, the setback weight will immediately return

to its original position, thereby returning the rotor to its unarmed position.

On the Mk 188 fuze a sustained acceleration of 13 to 15 g for 1/2 second drives the setback weight aft and the rotor continues turning to the armed position. On impact, the firing-pin shoulder is driven through the anti-setback washer; the firing pin fires the sensitive primer; and this, in turn, fires the detonator, lead-in, and booster, and detonates the head.

FUZE M 414 (PROXIMITY). The M 414 fuze, figure 11, is designed

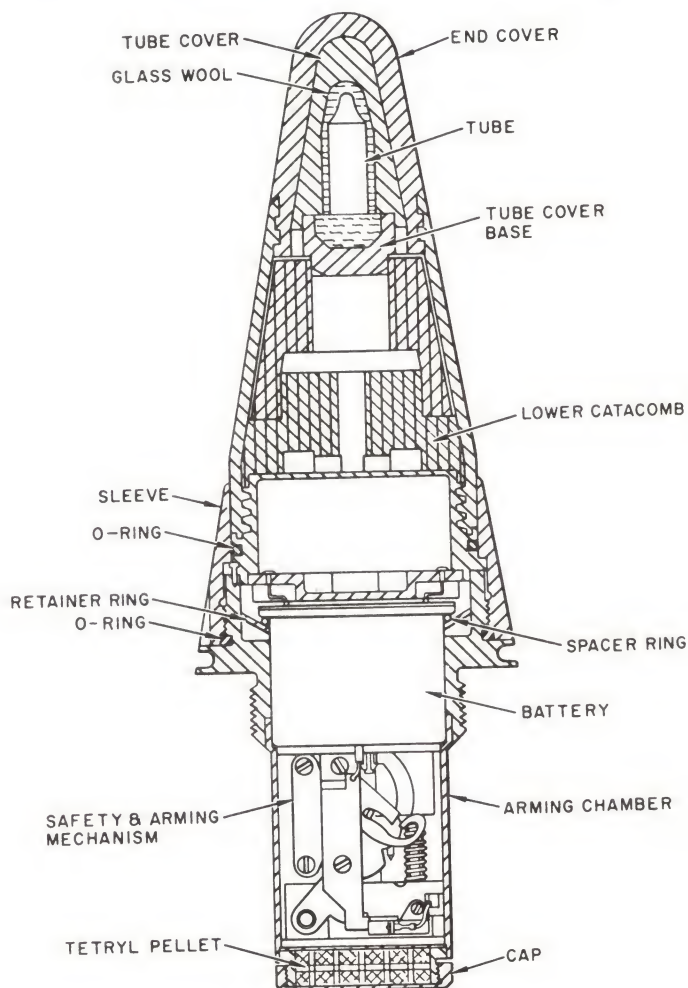


Figure 11 - Fuze M 414 (Proximity).

for use in the 5.0-inch Rocket Heads Mk 32 Mod 0, and Mk 24 Mod 0. In air-to-ground application, the warhead is detonated above ordinary terrain.

The safety and arming mechanism of the M 414 fuze assures the ZUNI a minimum safe air travel of 1100 feet under all firing conditions. The primary safety latch is not released in less than 1100 feet and impacting will not detonate the explosive train before the safety latch is released.

The safety and arming mechanism is a self-contained unit (no arming wire is required) that operates only on the setback forces characteristic of the rocket. It is an acceleration-integrating device that initiates the power supply and arms on the deceleration at the end of rocket burning.

When a rocket is fired as one of a salvo, its fuze will not function on another rocket in flight. This fuze is also carrier-safe.

FUZE MK 191 MOD 0 (BD). The Mk 191 Mod 0 base-detonating fuze is an electromechanical, acceleration-arming, impact fuze installed in the base of the 5.0-inch Rocket Head Mk 24 Mod 0 at the time the head is loaded with high explosive. The fuze is permanently screwed into the base of the head. The connection is sealed against moisture or motor gases by a gas-check of lead and copper inserted under heavy pressure, and an O-ring seal. The fuze is armed by an acceleration of 20 g or more and functions 0.005 second after impact with target. The arming distance of the fuze, when ground-launched and subjected to sustained acceleration of 50 to 100 g, is between 400 and 1000 feet.

Figure 12 shows the Fuze Mk 191 Mod 0 in unarmed and armed positions.

Two out-of-line acceleration-arming mechanisms provide primary safety. The rear mechanism, next to the primer is inert and contains the linkage to remove the shorting wire from the primer. The forward mechanism contains a detonator which lines up next to the booster-pellet lead-in. A shorting wire across the primer provides secondary safety. The short prevents premature actuation of the primer by the magnetic impact generator. When the rear mechanism arms under a sustained acceleration force, it releases a linkage-and-plunger arrangement that snaps the shorting wire.

When the rocket reaches the required acceleration, the setback weights on both arming mechanisms move aft and the rotors begin to arm. When fully armed, these rotors are locked in place by a detent, and the explosive train then is lined up. When the rear mechanism is armed, it releases a spring-loaded plunger to shear the primer-shortening wire. The fuze then is fully armed and ready to function on target impact.

On impact, an Alnico magnet breaks away from an iron keeper which is centered in a wire coil. Flux lines are interrupted and sufficient energy to fire the primer is inducted in the coil. The fuze is also carrier-safe.

LAU-10/A Launcher

The LAU-10/A launcher is a dual-purpose unit used for shipping the rocket motors, and for launching the ZUNI rockets.

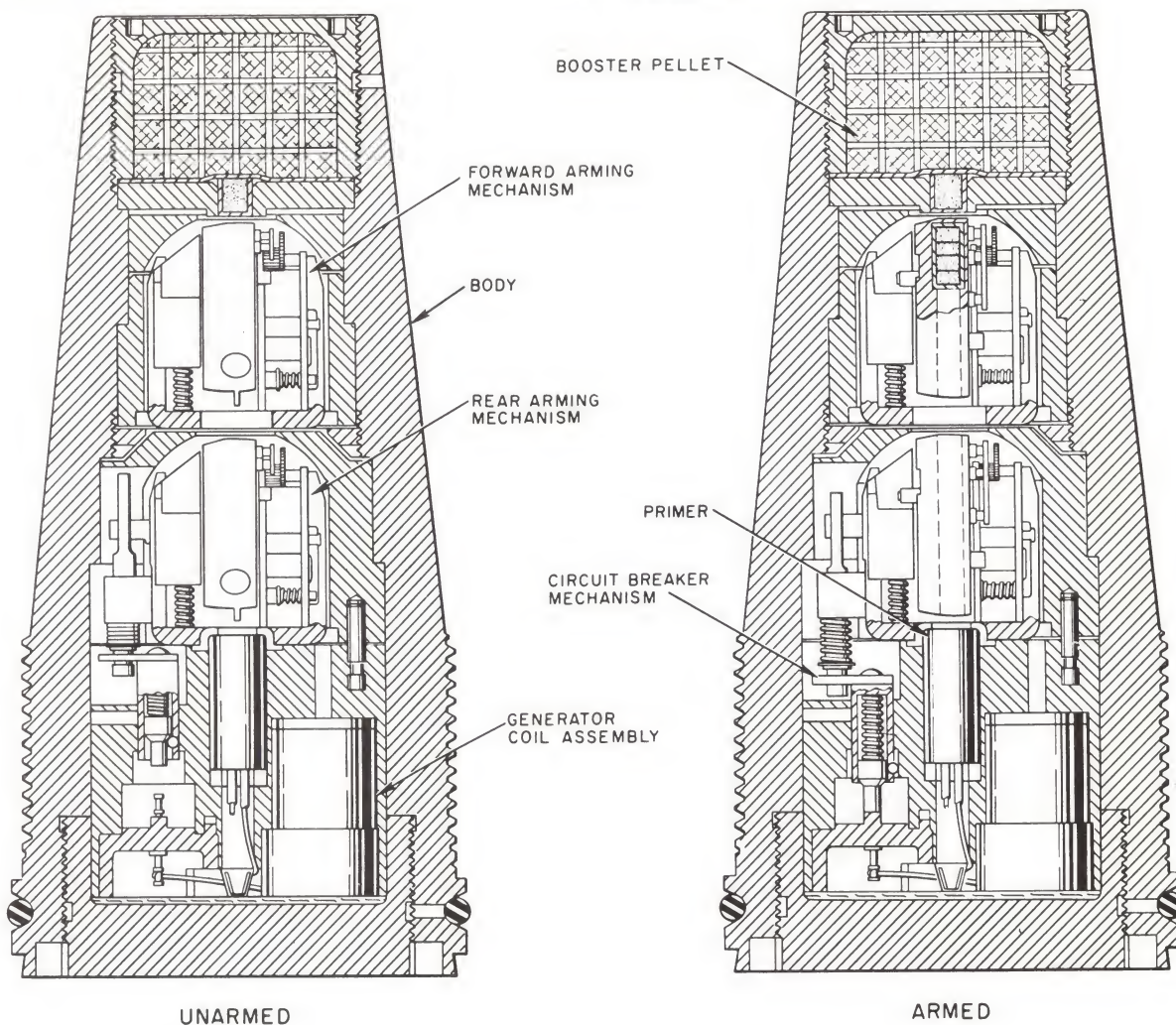


Figure 12 - Fuze Mk 191 Mod 0 (BD), Unarmed and Armed.

When used as a shipper package, the LAU-10/A launcher consists of the launcher center section with four ZUNI rocket motors, the shock pans, end covers, and locking rings, figure 13. In shipping configuration, the launcher is 98 inches long with a 16 by 16.5-inch cross section, weighs 140 pounds empty, and 380 pounds loaded only with motors. The launcher is a white container with multiple-suspension lugs compatible with all Navy and Air Force tandem-suspension 14- and 30-inch bomb racks, plus the British single-suspension bomb racks.

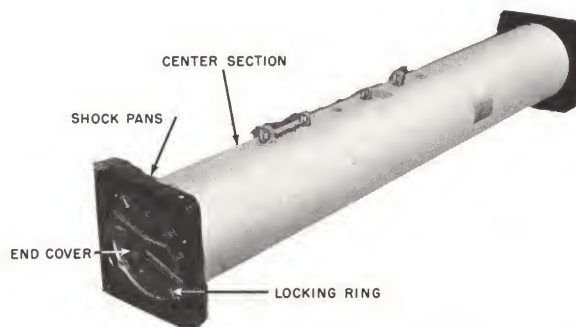


Figure 13 - LAU - 10/A Launcher Showing Main Parts.

The launcher center section contains the four launcher tubes, each equipped with a sear-type detent latch, the electrical ignition system, using a selector switch and an intervalometer giving ripple or single shot firing, and the suspension lugs.

Frangible Fairings

Six frangible fairings, enough to equip three launchers, are shipped in a separate package, figure 14. These streamlined fairings are made of treated paper and shatter readily on rocket movement or rocket blast. The fairing has a metal band at the base equipped with lugs and a leaf-spring for attaching it to the launcher center section by means of bayonet lock grooves. The metal band remains on the launcher after firing. The lugs engage the grooves in the center-section retainer rings, and as the fairing is rotated clockwise, the spring clip drops into position to lock the fairing securely in place. The fairing fits flush with the outside surface of the center section to form an aerodynamically smooth joint.

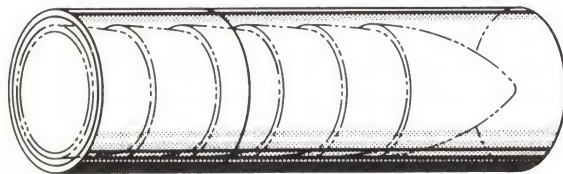


Figure 14 - Frangible Fairings.

Ignition

When the firing circuit is actuated, the electrical current passes through the aircraft firing circuitry and to the intervalometer in the launcher. Contact with the motor

is made through the contact band at the forward end of the motor, and from there through the lead wire to the squib in the igniter. The current then passes via the squib ground wire through the igniter case and to the rocket body, which is grounded through the launcher detent. From the launcher body, current passes through the detent to the suspension lugs and to the airframe ground, figure 15.

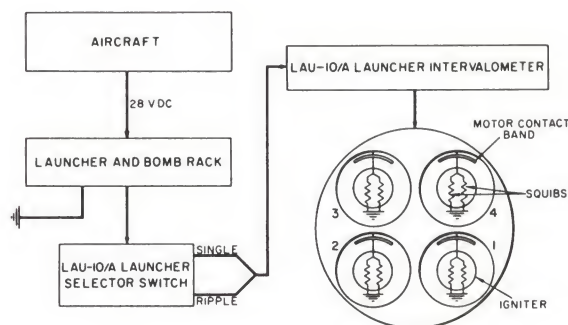


Figure 15 - Simplified Firing Circuit Diagram.

Current entering the squib heats the bridge wire, setting off the squib primer mixture which, in turn, ignites the igniter charge. Pressure within the igniter unseats a blowout plug, permitting the burning igniter charge to ignite the propellant grain. The whole process of ignition takes about 0.06 second. Pressure of the hot propellant gases from the burning grain bursts the nozzle seal and provides the thrust to propel the rocket.

Physical and Performance Characteristics

The physical and performance characteristics of the ZUNI are given in Table 2.

Table 2 - Physical and Performance Characteristics

Physical

Nominal diameter, in.	5.0
Bourrelet diameter, in.	5.125
Maximum length, in.	110.0
Loaded weight, lb.	107.0
Burnt weight, lb.	72.5
Fuzed warhead, weight, approx. lb.	48.0

Performance (based on temperature of propellant, 70°F)

Maximum velocity, vacuum, f.p.s.	2300
Maximum velocity, 2000-ft. alt., f.p.s.	2150
Maximum acceleration, 2000-ft. alt., <u>g</u>	86
Time to 3000 ft., ground-fired, sec.	1.85
Time to 3000 ft., 550-knot launch-velocity, sec.	1.33
Burning time, sec.	1.04
Burning distance, ground-fired, ft.	2090
Motor pressure, p.s.i.	1980
Average thrust, lb.	7850

Chapter 3

OPERATION

General

Operating principles used in the ZUNI system have been proved in other armament. The rockets may be single- or ripple-fired. The firing pulse is distributed to the individual rockets by an inter-valometer which is mounted in the launcher forward retainer ring. The ignited rocket overrides the sear detent latch and is released. The frangible fairings shatter readily on firing. When the rockets leave the launcher, fins open and are held in flight position against aerodynamic drag.

Rocket Firing Sequence

The electrical circuitry of the rocket ignition-aircraft system is shown in figure 16. Electrical power for the system is supplied to the launcher by the 28-volt-DC armament circuit of the aircraft. Electrical connection between the aircraft and the launcher is made through either of two parallel 5-pin receptacles located in the vicinity of the lugs in the center section of the launcher. As a safety requirement each receptacle is fitted with a shorting device, figure 17, which shorts the aircraft armament circuit

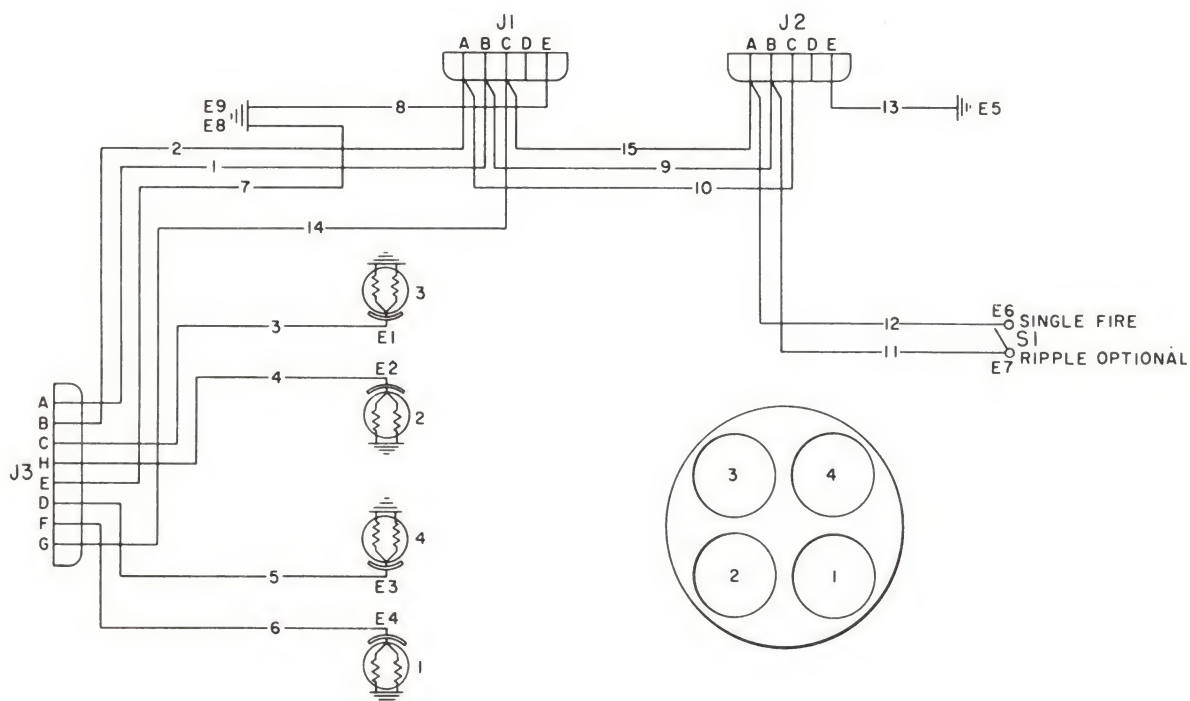


Figure 16 - Rocket Ignition-Aircraft System, Electrical Diagram.

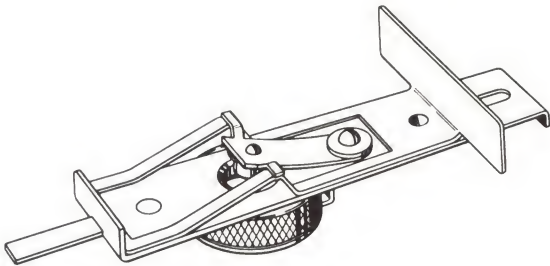


Figure 17 - Shorting Device.

preventing inadvertent operation of the intervalometer. Pins A and B of the receptacles are positive connections to the aircraft. Pin E is the negative connection and is grounded to the launcher-hangar beam which, in turn, is grounded to the aircraft through the suspension lugs.

A selector switch, figure 18, is located in the aft retainer ring of the launcher for preflight selection of either RIPPLE or SINGLE firing of the rockets through the intervalometer. The intervalometer is designed so that when single-fire is selected, the intervalometer fires one rocket on each ignition pulse from the aircraft. When ripple-fire is selected, the intervalometer converts the ignition pulse into ripple pulses and fires all the rockets at approximately 100-millisecond intervals. The firing circuit must be energized continuously for 0.5 second to assure a complete fire-out on ripple firing. When the intervalometer makes a complete four-round firing cycle, it automatically homes on the original, ZERO, starting point, and will not recycle without first de-energizing the circuit, and then re-energizing. The intervalometer contacts are arranged so that when the intervalometer is not energized, the rocket squib leads are shorted.

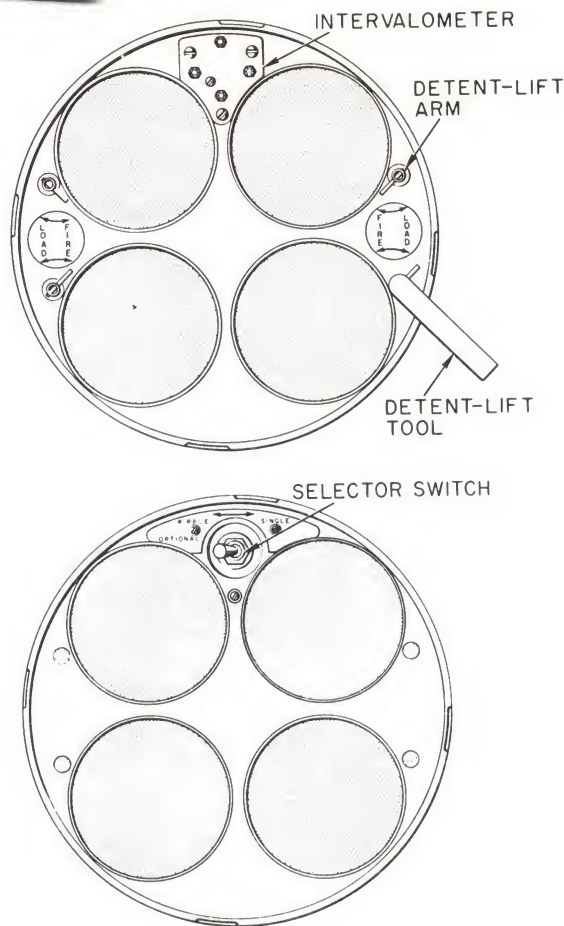


Figure 18 - Front and Back Views of Launcher.

Circuitry to the rocket motor is through a contact post in the detent subassembly. The post makes contact with the contact band on the motor tube. The contact band at the forward end of the motor is covered by a shielding band which seats in the motor detent groove and covers the ignition contact band, thereby providing protection against radio-frequency energy.

NOTE: A minimum firing current per round of 1.5 amperes for 10 milliseconds is required; the recommended firing current

per round is 3.0 amperes. If the current drops below 1.5 amperes, increase in delay of the ignition may be expected. The loaded igniter has a resistance of 0.35 to 0.80 ohm.

Launcher Preparation and Use

The LAU-10/A is used as a shipping container and as a launcher for the 5.0-inch ZUNI rockets. Procedures for preparing the launcher for aircraft installation and for flight, and instructions for launcher loading and unloading of rockets and motors are given in the following paragraphs.

PREPARING AIRCRAFT FOR LAUNCHER INSTALLATION. In testing the aircraft armament circuit, aircraft generator power only should be employed. The use of an auxiliary power unit will result in an invalid test.

NOTE: Before proceeding with tests of the aircraft armament circuit, check the following:

- a. Master Armament Switch - On
- b. Firing Control Override - Energized
- c. Rocket - Bomb Selector: to Rockets
- d. Station Selector - to Station being tested.

1. Increase engine speed until cockpit voltmeter indicates full system voltage--28 volts.

2. Using a 0- to 10-amperes meter, measure the current available to the LAU-10/A launcher.

3. Energize the station being tested and note the reading. The ammeter should register a minimum of 3.0 amperes. A pulse of less than 3.0 amperes might not fire all four rockets.

4. Place the armament switches in OFF position.

PREPARING LAUNCHER FOR BOMB RACK ATTACHMENT.

WARNING

The LAU-10/A launcher shall not be attached to a bomb rack that does not have separate ignition and jettisoning circuits.

The procedures for preparing a launcher with a forward firing receptacle and one with an aft firing receptacle are given in the following paragraphs.

WARNING

The launcher has two shorting devices. Make sure the shorting device being used is in the SAFE position until aircraft is ready for takeoff.

Forward Firing Receptacle. The procedure for use of forward firing receptacle is as follows:

1. For bomb racks of the Aero 15 and Aero 25 series that have forward rocket firing pins (striker arms), remove the shorting device from the forward launcher receptacle. Save this shorting device for reinstallation when the launcher is removed from the aircraft.

2. Make sure the shorting device in the after receptacle is in the SAFE position.

3. Install the ignition post in the forward receptacle.

4. Launcher is ready for attachment to aircraft.

Aft Firing Receptacle. For all other bomb racks, such as the Aero 20A, Aero 7A, and the Mk 51, an umbilical cable, not supplied, between aircraft bomb rack and launcher, figure 19, must be used.

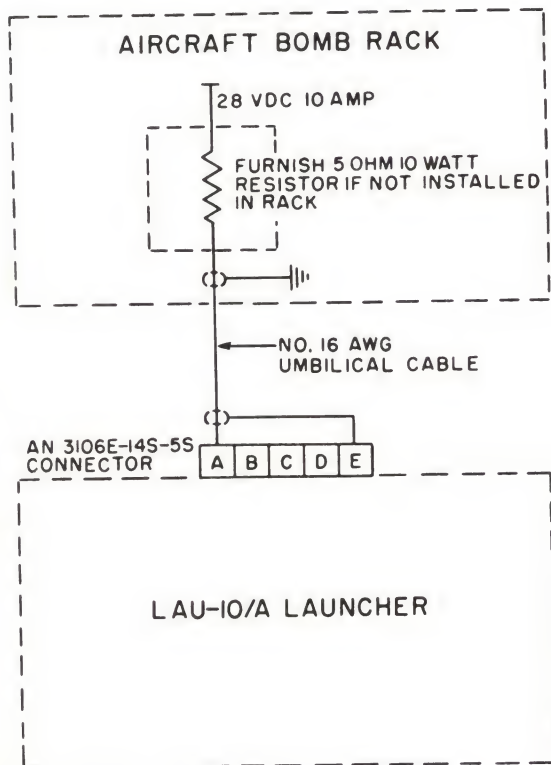


Figure 19 - Umbilical Cable Between Aircraft Bomb Rack and LAU-10/A Launcher.

The procedure is as follows:

1. For racks using the rear contact receptacle, remove and

save the shorting device from the after receptacle.

2. Make sure shorting device in the forward receptacle is in the SAFE position.

3. Launcher is ready for attachment to aircraft.

NOTE: Do not move shorting device from SAFE to ARM until after the aircraft has received a stray-voltage check, and is ready for takeoff.

4. For racks with only 14-inch suspension lugs, Aero 15 series, remove the 30-inch suspension, BuAer Dwg 54A46C358, from the LAU-10/A launcher, figure 20.

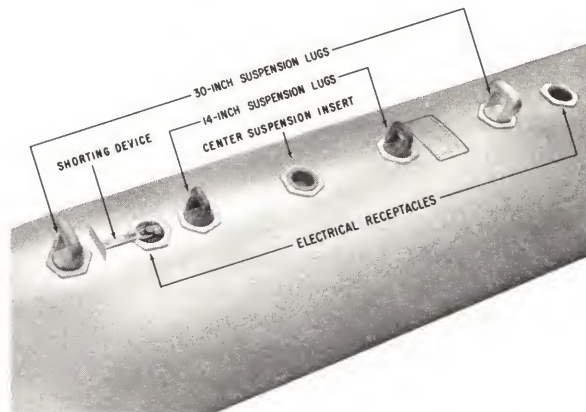


Figure 20 - Section of Launcher Showing Suspension Lugs and Electrical Receptacles.

5. For all other racks, remove the 14-inch suspension lugs, BuOrd Dwg 1252628.

6. For single-lug suspension, remove both the 14- and 30-inch suspension lugs, and install the British suspension lug, not provided, in the center position.

NOTE: When the launcher is to be used on a bomb rack with both 14- and 30-inch suspension hooks, the 30-inch suspension shall be used.

7. Adjust the suspension lugs to the vertical dimension shown on the decal opposite the lugs. Dimension is to be from the inside top of the lug to the face of the threaded insert. If lugs are not 90 degrees to the horizontal centerline of the launcher, back off enough to align.

ATTACHING LAUNCHER TO BOMB RACK. The steps for attaching the launcher to bomb rack are as follows:

1. Swing locking-ring handles outward until the latches engage the shock pans, figure 21. This step provides a means for lifting the launcher to the bomb rack.

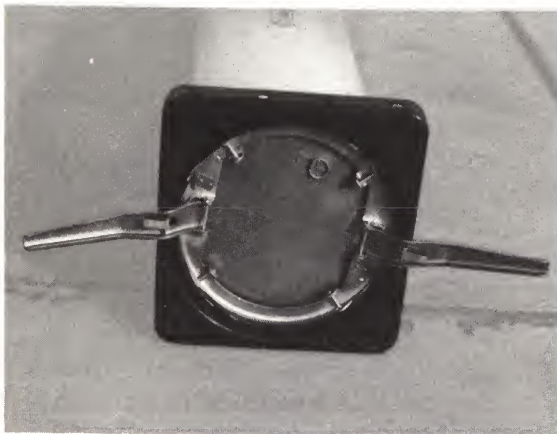


Figure 21 - Launcher with Handles Extended for Manual Handling.

2. Using the four handles, lift the launcher assembly and place it in the bomb rack and lock the suspension lug hooks.

3. Position the bomb-rack sway braces to support the launcher rigidly in accordance with current operating instructions.

ATTACHING HEADS, FUZES, AND FAIRINGS. The final steps in preparing the ZUNI for flight are as follows:

1. Disengage locking-ring handles from the shock pans.

2. Break or cut lockwires holding locking rings to the shock pans.

3. Rotate locking rings, with handles, in a counter-clockwise direction until pins are disengaged from slots in shock pans, and remove the locking rings.

4. Remove the front and rear covers.

5. Lift the spring latches on the shock pans, rotate the shock pans counter-clockwise as far as possible, and pull them away from the center section of launcher. Shock pans, covers, and locking rings should be stowed in a suitable, convenient place for re-use.

NOTE: Refer to NOTES in Maintenance and Storage, Chapter 4, and to Special Precautions, Chapter 5, on handling the heads.

6. Screw the rocket heads into the rocket motors and tighten securely with a chain or spanner wrench to a torque of approximately 100 foot-pounds. Heads and fuzes may be preassembled. Fuzes should be tightened with a spanner wrench to 40 foot-pounds of torque. The rocket stop in the after end of the launcher prevents the motor from

turning while the heads are being screwed in place. Figure 22 shows rockets in LAU-10/A launcher.

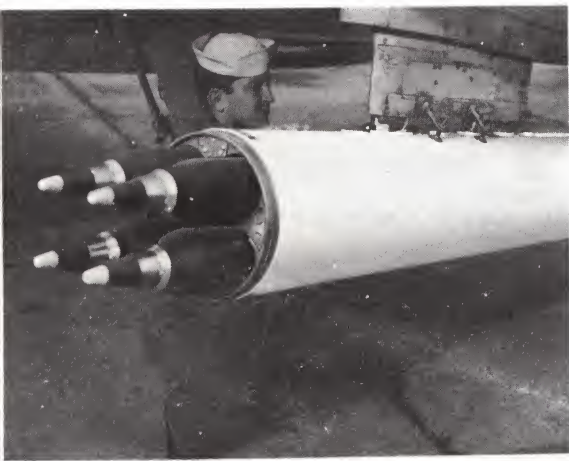


Figure 22 - Rockets Shown in LAU-10/A.

7. Set the selector switch, figure 18, of the launcher on RIPPLE-OPTIONAL position or on SINGLE position as indicated by the mission.

8. Remove the frangible fairings from the container.

9. To attach fairing to each end of launcher, align the arrow on the fairing with the arrow on the launcher marked UNLOCK.

10. Push the fairing onto the center section of the launcher until it is seated against the retainer ring.

11. Rotate the fairing clockwise until the spring latch "clicks" into the locked position. The red arrow on the fairing should align with the red arrow on the launcher marked LOCK.

ARMING CHECK. Standard arming stray-voltage check is to be

performed in accordance with existing instructions.

1. Complete the electrical connection between the launcher and bomb rack by dropping the striker arm or by attaching the umbilical cable inside the bomb rack, depending on the type of rack being used.

NOTE: The greatest single cause of firing failure is the lack of electrical continuity between the aircraft and the rocket.

2. Just before takeoff, place the shorting device in the ARM position.

REMOVING LAUNCHER FROM AIRCRAFT. To remove the launcher from the aircraft, proceed as follows:

1. Place the shorting device on the launcher in the SAFE position immediately after returning from flight.

2. Remove fairings.

3. Remove rocket heads; remove the nose fuze from the head; and return heads and fuzes to magazine storage.

4. Replace the shock pans, covers, and locking rings.

5. Disconnect the launcher from the aircraft and return the launcher to magazine storage.

LOADING ROCKET MOTORS INTO LAUNCHER. To prepare the launcher for loading with four ZUNI motors, it is necessary to remove only the forward locking ring and cover, figure 23.



Figure 23 – Launcher with Locking Ring and Cover Removed.

With the launcher in the horizontal position, proceed as follows:

1. Check the shorting devices for SAFE positions.
2. Swing locking-ring handles out, but do not engage handle latches with the shock pans.
3. Use the handles to turn the locking ring in a counter-clockwise direction to disengage and remove the locking ring from the shock pans.
4. Be sure that detent pawl is properly seated; check DETENT RE-COCKING PROCEDURE, Chapter 4, page 28.
5. Then rotate all dentent-lift arms to the LOAD position, figure 24.

WARNING

To prevent accidental ignition by electromagnetic or electrostatic energy, the shielding band must be left in place until just before

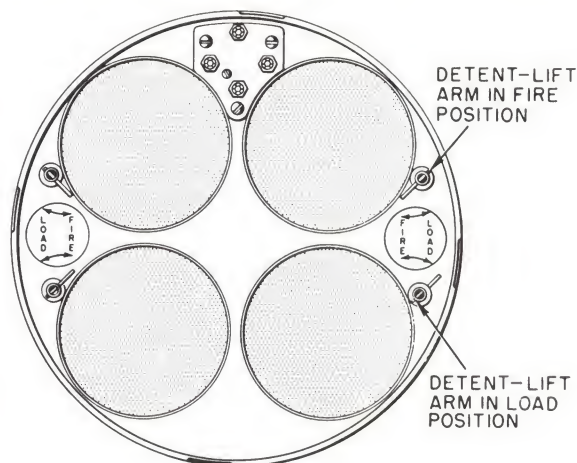


Figure 24 – Forward View of Launcher Showing Detent-Lift Arm in FIRE and LOAD Positions.

the contact band enters the launcher.

6. Insert the after end of the rocket motor into the forward end of the launcher and push slowly. Remove the shielding band from the motor contact just before it enters the tube. Continue to push slowly until the nozzle plate of the rocket motor comes in contact with the after stop in the launcher tube.

7. Using the detent-lift tool, rotate the detent-lift arm, figure 24, to the FIRE position.

8. Pull or push the motor forward until the detent drops into the detent groove. An audible click indicates positive engagement of the detent with the detent groove.

9. Repeat the above procedure until all four motors are loaded into the launcher.

WARNING

Firing circuit continuity check with rocket motors installed in the launcher should be made only by a Naval Ammunition Depot and should be made in strict conformance with the specified procedures, using equipment designed specially for that purpose.

10. Install the cover.

11. Install the locking ring by engaging the locking pins in the slots in the shock pan, and by the use of the handles rotate clockwise until the pins bottom at the end of the slots.

12. Fold the handles in and lock them in place with the spring clips provided for that purpose.

UNLOADING ROCKET MOTORS FROM LAUNCHER. In the event it is necessary or desirable to remove the rocket motors from the launcher, proceed as follows:

NOTE: Comply with safety precautions pertaining to launcher loading and unloading, Chapter 5.

1. Rotate the detent-lift arm to the LOAD position, figure 24.

2. Pull or push the motor forward until the contact band is clear of the forward end of the launcher.

3. Install the shielding band over the contact band.

WARNING

During loading or unloading operations do not touch the rocket motor contact band.

4. Remove all motors from the launcher and immediately place them in magazine storage.

5. Rotate the detent-lift arm of the launcher to the FIRE position, Figure 24, and leave it in that position until ready to load the launcher again.

6. If all or part of the rocket load is not expended, unfired rounds, less misfires, shall be returned for re-use. The LAU-10/A Launcher is capable of making repeated arrested landings and catapulted launchings, either partly or fully loaded.

7. In the event that any rounds do not fire after firing switch is actuated, launcher with misfired round or rounds should be jet-tisoned before landing.

Chapter 4

MAINTENANCE AND STORAGE

NOTE: These instructions should be studied carefully before the weapon components are stored, assembled, or loaded in launchers. They should be referred to again, as necessary, during assembly, storing, or loading operations.

Motor

General instructions for handling rocket motors apply to the ZUNI motor. Because of the length, weight, and thin web of the propellant grain, it is susceptible to damage. Extra precautions must be taken against dropping, jarring, or bumping the motor. A sudden jolt from a drop may crack the propellant grain. This could cause the motor to blow up when the rocket is fired. Propellant grains crack more readily at low temperatures. Motors, if dropped while in the horizontal attitude, are damaged more severely than when dropped vertically.

WARNING

If the motor is dropped and any portion impacts after falling 18 inches or more, do not use. If convenient, return motor to the issuing agency with a tag showing pertinent information.

Standard magazine-storage regulations should be observed. The motors should be stored in a magazine with the temperature maintained below 90° F; however, storage at temperatures up to 100° F for less than 6 months is permissible.

WARNING

The lower storage limit for the ZUNI rocket motor is -30 degrees Fahrenheit. Should any motors be exposed to a colder temperature they shall be conditioned at a temperature above -30 degrees Fahrenheit for six hours before being used to arm aircraft.

Heads

Instructions for handling high-explosive components apply to the handling and storage of the ZUNI heads.

The 5.0-inch Rocket Heads Mk 32 Mod 0 (ATAP), and Mk 24 Mod 0 (GP) are usually shipped one or two in wooden boxes. A shipping plug with a gasket is screwed into the nose end and a shipping cap is screwed on the base end. These shipping plugs and caps should be left in place until the heads are to be assembled to motors and fuzes. This precaution prevents damaged

or dirty threads which would make assembly of the rocket difficult or even impossible.

The 5.0-inch Rocket Head Mk 33 Mod 0 (Illuminating) is delivered complete in a metal container, 5.0-inch Rocket Container Mk 24 Mod 0, BuOrd Dwg 657764, which can be stacked horizontally for storage.

The illuminating heads are subject to the same storage regulations as other pyrotechnic devices, such as illuminating projectiles, and are not authorized for ready-service stowage.

NOTE: Hygroscopicity (tendency to absorb moisture) of the pyrotechnic candle and the black-powder ejection charges make cool, dry stowage of this head essential. Hence, it must be stored in its moisture-proof metal container in a cool place. All unused heads should be returned to their containers.

Because the life of the explosive components of this head is not fully known, the oldest lots, as determined by the loading-station identification stamp, should be used first.

Containers should be inspected periodically for external evidence of deterioration. If there are signs of deterioration, the container should be opened and the head should be examined for corrosion and the presence of fumes or chemical odors. If corrosion or fumes are evident, the head should be considered unsatisfactory for use and is to be turned in or disposed

of by dumping in accordance with safety regulations in effect.

NOTE: Shipboard disassembly or repair of this head is not authorized.

Fuzes

Nose fuzes are shipped in separate containers. All general handling, storing, and maintenance procedures and safety precautions for components containing high explosives assembled with detonators apply.

LAU-10/A Launcher

Loaded launchers must be stowed in approved rocket magazine stowage.

The LAU-10/A launcher is both a combat launcher and a reusable training device. Reasonable care and maintenance should be exercised in its use. Continued satisfactory operation can be assured by cleaning the firing-contact points after every firing and before loading after extended non-use. Fine emery cloth should be brushed over the firing-contact points to assure good contact. In order to enable repeated attachment of fairings, care should be taken not to mark, scar, or burr the retainer ring. A fine file should be used to remove any scars or marks that do occur.

The LAU-10/A launcher should have a minimum useful life for firing approximately 100 rockets or 25 salvos. During wartime or during aircraft emergencies, the launcher may be jettisoned at the option of the pilot.

Launchers damaged seriously enough to impair loading or firing of rockets shall be discarded. Launchers that develop operational difficulties that cannot be corrected by simple repair or replacement of parts shall be discarded.

Tests of Launcher Intervalometer. The following procedures should be employed using a 24-30-volt-DC power source: Figure 25 shows the intervalometer removed from the launcher for continuity check, which is done only at NAD.

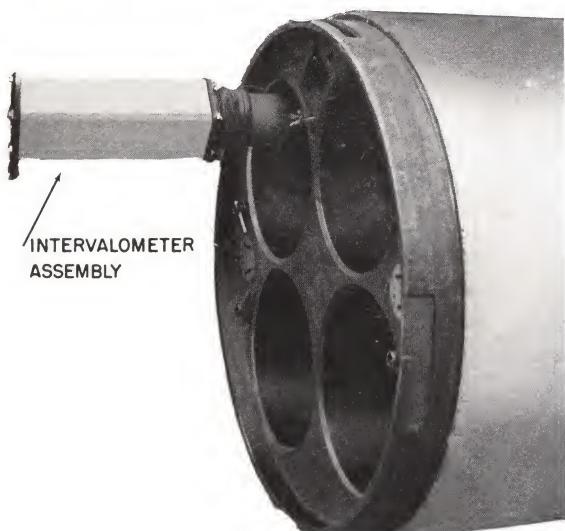


Figure 25 - Intervalometer Removed from Launcher for Testing at NAD.

WARNING

Tests of the intervalometer shall never be made except on empty launchers.

1. Remove shorting device from one receptacle and place the other shorting device in ARM position.

2. Attach positive lead to pin A in electrical receptacle, figures 16, 19, and 20.

3. Attach negative lead to pin E (ground).

4. Set selector switch on SINGLE; apply voltage across pins A and E; intervalometer should step once and stop, delivering a firing pulse to the No. 1 contact post. Repeat this operation for four pulses, at which time the intervalometer will stop on the original ZERO position.

5. Repeat step 4 with selector switch on RIPPLE-OPTIONAL position; the intervalometer should run continuously, delivering a firing pulse successively to all contact points, then stop and home on the original ZERO position.

WARNING

Before reloading a used launcher, the intervalometer shall always be operated as indicated in step 5 above and left in the home or original ZERO position.

To check the intervalometer-to-rocket firing pulse, proceed as follows:

1. Arrange the shorting devices as in step 1 of procedure already listed.

2. Attach the positive lead of the voltmeter to the contact post located aft of the detent pawl; check DETENT RE-COCKING PROCEDURE, Chapter 4, page 28.

3. Attach the ground lead of the voltmeter to any convenient portion of the launcher, such as the retainer ring or suspension lug.

4. Set the voltmeter on the lowest scale reading (0 to 2.5 VDC

scale). The voltmeter will not indicate current passage if a higher scale is used, since the ignition pulse lasts for only 20 milliseconds.

5. Set the selector switch on SINGLE position.

6. Apply voltage across pin A and pin E.

7. The voltmeter indicator arm will move quickly to indicate passage of current and return to ZERO reading immediately. Repeat for each contact post.

8. Set the selector switch on RIPPLE-OPTIONAL.

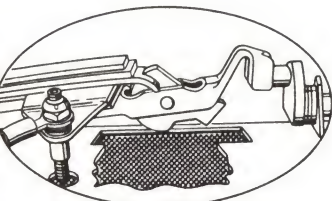
9. Repeat step 6.

10. The voltmeter will pulse as in preceeding step 7 and return to ZERO. With a single-channel voltmeter, repeat this procedure for each contact post.

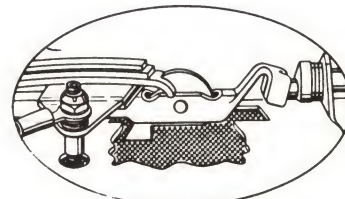
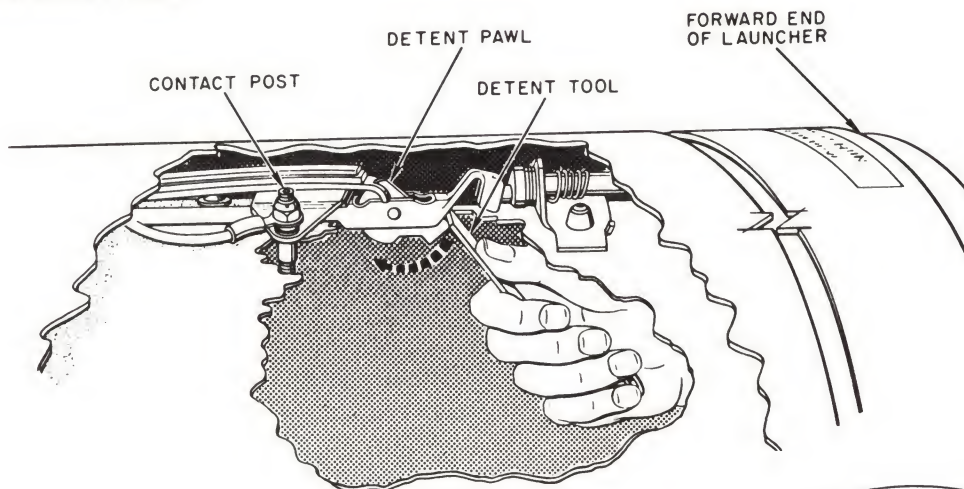
Detent Re-Cocking Procedure. To re-cock the detent after a rocket is fired, proceed in the following manner, figure 26:

1. Rotate the detent-lift arm to the FIRE position.

2. Insert handle portion of detent-lift tool into launcher tube and engage the forward edge of the detent



AFTER ROCKET FIRING



COCKED POSITION

Figure 26 - Cutaway of Launcher Tube Showing Method of Detent Re-cocking After Rocket Firing.

pawl within the detent-clearance hole in the launcher tube.

3. Push the detent pawl down and aft. The detent pawl will rotate about its axial pin and snap back into the seated position.

4. Rotate the detent-lift arm to the LOAD position. The launcher is now ready to be reloaded.

5. If the launcher is not going to be reloaded for some time, leave the detent-lift arm in the FIRE position.

Frangible Fairings

The frangible fairings in their container may be placed in any convenient inert stowage place.

Chapter 5

SAFETY PRECAUTIONS

Storing and Handling Precautions

All safety precautions normally followed in storing and handling rocket components shall be observed. The precautions include the following:

1. Adhere to all storage conditions specified for smokeless powder and high explosives.
2. Store motors only in approved rocket motor magazines. Do not store near electrical panels or live wires. Comply with existing restrictions for handling and loading of ordnance while in electromagnetic fields.
3. Store heads and fuzes in appropriate magazine storage. Store Mk 33 (Illuminating) head in a cool, dry place.
4. Handle motors carefully at all times. Avoid jarring or dropping, as a cracked propellant grain may be the cause of a motor blow up on firing. Motors dropped more than 18 inches should be returned to the issuing agency. Motors dropped less than 18 inches should be examined carefully for external damage. If no damage is evident, they may be considered safe for use.
5. Do not expose the rocket motor to temperature below -30 degrees Fahrenheit or above +165 degrees Fahrenheit

for more than 1 hour. If the motor has been exposed for more than one hour to temperatures outside these limits, maintain the motor within the safe storage temperature limits for 6 hours before firing.

6. Do not tamper with, or attempt to repair, any parts of the round. If the round is damaged or defective, remove the head and fuze from the motor and mark the defective part for return to the issuing activity.

7. Do not attempt to remove the base fuze from the head by field activities, except by qualified bomb-disposal personnel.

8. Do not remove the shielding band from the contact band until just before loading the round into the launcher. Always immediately replace the shielding band on rockets as they are removed from the launcher.

9. Make sure the firing system cannot be energized during launcher loading and unloading operation.

10. Keep well away from the front and rear of rockets loaded or unloaded.

Special Loading and Unloading Precautions

Before performing any operation of loading rockets or rocket motors into the launcher or removing rockets

or rocket motors from the launcher, make sure all applicable conditions of safety have been complied with as follows:

1. Do not attempt to load or unload either completely assembled rockets or rocket motors in the vicinity of radio-transmitting antennas. Refer and conform to current restrictions on handling and loading ordnance in electromagnetic fields.

2. Make sure the launcher firing circuit is not, nor can it be, energized and at least one shorting device is in place in the SAFE position.

3. Under certain conditions on shore stations, it may be desirable to load or unload launchers while they are suspended on aircraft. Before doing so, refer to safety conditions in paragraphs 1 and 2.

4. The LAU-10/A launcher shall not be attached to a bomb rack that does not have separate ignition and jettisoning circuits.

5. For shipboard operations, the rocket motors shall be installed in the launcher in a safe area, preferably below deck. The launcher shall be properly suspended from the aircraft, then the rocket heads shall be screwed onto the motors. See page 33, para. "a" for special instructions involving safety of base fuze heads. The appropriate fuze then is attached to each head. All Mark 24 Mod 0 live loaded heads are issued with base fuze in place. If base fuze is not in place the head shall not be used. The frangible fairings are then placed on the ends of the launcher. Unloading operations shall be ac-

complished in the reverse order of the procedure already discussed.

6. Partially fired launchers shall be unloaded in accordance with these procedures.

7. Continuity checks, intervalometer checks, and positioning shall be accomplished in accordance with existing instructions. No electrical continuity check of the igniter shall be conducted aboard ship.

a. Firing circuit continuity check with rocket motors installed in the launcher should be conducted by a Naval Ammunition Depot only and in strict conformance with specified procedures, using equipment designed for that specific purpose.

b. Tests of the intervalometer, as outlined in MAINTENANCE AND STORAGE, Chapter 4, shall never be made except on empty or unloaded launchers.

c. Before reloading a used launcher, the intervalometer shall be tested as outlined in Chapter 4, and left in the original ZERO position.

8. The rocket shielding band shall be in place on the rocket motor at all times when it is not in the launcher.

9. For shore-station ground-firing operations, in the event of a misfire, no attempt shall be made to remove the rocket from the launcher until the ignition circuit has been made completely safe.

10. Before installing a rocket motor or complete rocket in the launcher, make a careful inspection

to insure that the round is properly assembled. Do not load the round into the launcher if the fins are bent, or if the motor contains scratches which penetrate into the metal.

11. LAU-10/A Launcher shall not be attached to a bomb rack which does not have separate ignition and jettison circuits.

WARNING

Mk 24 Mod 0 Head Only

a. No attempt should be made to remove the base fuze except by qualified bomb-disposal personnel. The Mark 191 Base Fuze and Gas Check Gasket are used with every live loaded head. If base fuze hole is uncovered or has any other plug or cover, the Head shall not, repeat not, be used but will be returned to the nearest Naval Ammunition Depot. Base Fuze Hole in Mark 24 Mod 0 plaster filled PRACTICE head must be plugged with Base Fuze Hole Plug, Piece No. 457600. This piece is indent stamped "FOR INERT LOADED HEADS ONLY". If this piece is not in place, Head will NOT be used, but will be returned to nearest Naval Ammunition Depot. Failure to comply with these directions can result in premature detonation of the head with attendant loss of life and materiel.

b. Leave heads in shipping container as long as possible

when loading aboard or striking down.

c. When off-loading, provide shipping container Mk 34 box or Mk 11 pallet adapter. Secure to pallet to prevent rolling off.

d. When handling individual heads, use extra caution. Do not drop. Treat any head dropped more than 10 feet as armed. For additional information see NAVORD INSTRUCTION 8042.17.

Special Safety Precautions for Mk 33 Mod 0 Head (Illuminating)

The handling and use of the 5.0-inch Rocket Head Mk 33 Mod 0 will not involve unusual hazards if the following safety precautions are observed:

1. All personnel who work with the illuminating head, or who teach or supervise its use, should become familiar with OP 1239 and with ammunition-handling instructions.

2. Avoid exposing the head to temperatures above 100°F and store the head in a place protected from moisture.

3. Ground heads and isolate them from electrostatic charges.

4. Heavy parts are ejected when the illuminating head functions. Hence, pilots should use discretion in firing the flare rocket in order to avoid endangering friendly ground forces.

5. As the flare burns, its weight decreases. The rate of descent of the expended flare is,

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therefore, about 10 feet per second—substantially slower than during the burning period. Pilots are, therefore, advised to avoid

the region below the point of flare burnout long enough to eliminate the possibility of colliding with expended flares.

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Chapter 6

HANDLING INSTRUCTIONS FOR 5.0-INCH ROCKET MOTOR
MK 16 MOD 1

Following is a copy of the handling instructions packed with each ZUNI Motor:

All safety precautions normally followed in handling rocket ammunition shall be observed. These include the following:

1. Certain precautions must be observed in handling these rocket motors, since a sudden jolt occurring as the result of a drop may crack the propellant grain, causing a down range motor blow-up. This cracking of the propellant grain occurs more readily at low temperatures. When motor is in horizontal position when dropped, grain will crack more readily than when dropped while in a vertical position. It is imperative, therefore, that, in transporting, moving, or handling the motor, care must be exercised not to subject it to jolts from dropping or sliding against a solid object.

2. If a motor has been dropped 18 inches or more it shall not be used but should be returned to the U. S. Naval Ammunition Depot, McAlester, Oklahoma for examination. Motors dropped less than 12 inches should be examined for external damage; if no damage is evident, they may be considered safe for use.

3. Storage conditions which apply to smokeless powder also apply to rocket motors.

4. No smoking within 200 feet of rocket ammunition.

5. Do not store motors in the same compartment with or near radio or radar apparatus. Do not store adjacent to electric panels or live wires.

6. Do not touch or come closer than 4 inches to unshielded rocket contact band, except when installing head or shielding band, on weather decks, where there is a possibility of RF fields.

7. Do not tamper with, or attempt to repair, any parts of the rocket. If the rocket is damaged or defective, remove the head from the motor and mark the defective part for return to the originating facility.

8. MAKE SURE THE FIRING SYSTEM CANNOT BE ENERGIZED DURING LAUNCHER LOADING AND UNLOADING OPERATIONS.

9. Keep well away from the front or the rear of rockets loaded or being loaded.

10. Resistance within the motor circuit is .35 to .80 ohms. Minimum current for firing to be 3 amp D. C. Recommended voltage for firing is 24 volts minimum, with limiting resistance adjusted accordingly. Squib checking for continuity should be conducted with currents not to exceed 15 milliamperes.

Firing circuit continuity check of rocket motors should be conducted by a Naval Ammunition Depot only and in strict conformance with specified procedures, using equipment designed for that specific purpose. THIS FUNCTION SHOULD NEVER BE PERFORMED IN FLEET OR FIELD SERVICE ACTIVITIES. IT SHOULD ONLY

BE DONE AT NAVAL AMMUNITION DEPOTS as described.

11. The contact band is used for firing the motor.

12. Firing temperature limits are from -65 to +165° F.

13. Shielding band should be left in place until the rocket is ready for positioning in the launcher.

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SNDL Part 1 (No. 72) and Part 2 (No. 29)

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